Questions from pages 26, 27 of *ESA Study Guide Year 10 Science*

**Understanding**

1. Which early scientist thought atoms would combine to form new substances?

2. Which New Zealand scientist found that most of the mass of an atom is in its nucleus?

3. What is one aim for the Large Hadron Collider?

**Thinking and contributing**

**How big is an atom?**

You need a strip of paper 28 centimetres long and a pair of scissors.

Take your strip of paper and cut it in half – you now have two pieces of paper 14 cm long. This is your first ‘division’.

Cut one of the 14-cm-long pieces of paper into equal halves – you now have two pieces of paper 7 cm long.

Repeat cutting the same piece of paper into equal halves as many times as you can. When the width gets longer than the length, cut off the excess, but that does not count as a cut. If you can cut the strip of paper in half 31 times, you will end up with a piece of paper the size of an atom.

After carrying out some research online about the size of atoms, summarise what you have discovered from this activity and your research in one or two paragraphs.

Answers are provided on page 292 of *ESA Study Guide Year 10 Science*
Chapter 2: Atoms
Structure of an atom

Questions from page 28 of ESA Study Guide Year 10 Science

Understanding

1. Who first put forward the idea of ‘atoms’ and what does the word ‘atom’ mean?

2. Which is the lightest subatomic particle?

3. Copy and complete the following sentences using the words in the Word list. Some words may be used more than once.

   clouds dense negative neutrons positive protons quickly space

   Atoms are made up of subatomic particles called protons, a. ________________ and electrons. Protons carry a b. ________________ charge, c. ________________ carry no charge, they are neutral, and electrons carry a d. ________________ charge. The nucleus is the most e. ________________ part of the atom. It contains f. ________________ and neutrons. Neutrons prevent g. ________________ repulsing each other in the nucleus. Electrons are found in h. ________________ around the nucleus. The electrons move very i. ________________ around the nucleus. Apart from the nucleus, most of an atom is made up of j. ________________.

4. Draw a diagram of a helium atom. Label:
   • nucleus with protons and neutrons
   • an electron
   • space.

Thinking

In what way(s) are the previous diagrams of carbon and helium atoms inaccurate?

Contributing

Design and produce a poster that could be used to teach students in Year 7 about the structure of an atom. Make this information interesting and informative.

Answers (except for ‘Contributing’) are provided on page 292 of ESA Study Guide Year 10 Science
Questions from pages 29, 30 of *ESA Study Guide Year 10 Science*

**Understanding**

1. Write a definition for the word ‘element’.

2. Complete the following table.

<table>
<thead>
<tr>
<th>Name</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>lithium</td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td></td>
</tr>
<tr>
<td>Cl</td>
<td></td>
</tr>
<tr>
<td>Si</td>
<td></td>
</tr>
<tr>
<td>nitrogen</td>
<td></td>
</tr>
<tr>
<td>potassium</td>
<td></td>
</tr>
<tr>
<td>gold</td>
<td></td>
</tr>
<tr>
<td>Hg</td>
<td></td>
</tr>
</tbody>
</table>

3. What is the chemical symbol for magnesium?

4. Which two elements are liquids at room temperature?

5. Name three Group 18 gases.

**Thinking**

1. Suggest why elements such as gold are easy to find in nature, but other elements such as sodium do not occur as elements in nature.

2. Explain what the term ‘diatomic’ means, in terms of molecules.

**Contributing**

1. Use a complete periodic table and find out which elements on the periodic table are named after people and which elements are named after countries.

2. Learn the names of the first ten elements of the periodic table in order by heart. Test yourself with a partner.

Answers (except for ‘Contributing’) are provided on page 292 of *ESA Study Guide Year 10 Science*.
Questions from page 31 of ESA Study Guide Year 10 Science

Understanding

1. Describe the three subatomic particles that make up an atom, stating for each where it is found, its charge and its mass.

2. What does the atomic number of an element tell us?

3. What does the mass number of an element tell us?

4. What tells us the number of electrons in an atom?

5. The atomic number of nitrogen is 7.
   a. How many protons does an atom of nitrogen have? __________
   b. How many electrons does an atom of nitrogen have? __________

6. Explain what the following symbol and numbers tell us about an atom of chlorine: Cl

7. Copper, Cu, has an atomic number of 29 and a mass number of 63. Write the symbol and its numbers.

Thinking

1. Which subatomic particles make up most of the mass of an atom?

2. Which subatomic particles take up most of the space in an atom? __________

3. The atomic number for hydrogen is 1 and for helium is 2. In terms of protons and electrons only, explain the difference between a hydrogen atom and a helium atom.

4. Give the atomic number for each of the following.
   a. An atom with 5 protons in its nucleus: __________
   b. An atom with 7 electrons in shells around the nucleus: __________
   c. The atom that is number 4 on the periodic table: __________
   d. Carbon: __________

Answers are provided on page 293 of ESA Study Guide Year 10 Science

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Questions from page 34 of *ESA Study Guide Year 10 Science*

**Understanding**

1. a. Explain in words what this diagram of a carbon atom tells about the arrangement of electrons in the atom of carbon.

   [Diagram of a carbon atom]

   __________________________________________________________

   b. Express the diagram in a different way.

   __________________________________________________________

2. Complete the table. Neon has been done for you.

<table>
<thead>
<tr>
<th>Name</th>
<th>Electron arrangement</th>
</tr>
</thead>
<tbody>
<tr>
<td>neon</td>
<td>2,8</td>
</tr>
<tr>
<td>carbon</td>
<td></td>
</tr>
<tr>
<td>chlorine</td>
<td></td>
</tr>
<tr>
<td>lithium</td>
<td></td>
</tr>
<tr>
<td>magnesium</td>
<td></td>
</tr>
<tr>
<td>calcium</td>
<td></td>
</tr>
<tr>
<td>oxygen</td>
<td></td>
</tr>
<tr>
<td>sodium</td>
<td></td>
</tr>
</tbody>
</table>

3. What are ‘isotopes’?

   __________________________________________________________

4. How many *neutrons* are in the following isotopes of carbon? (Carbon has 6 protons in its nucleus.)

   a. Carbon-12: __________________

   b. Carbon-13: ________________

   c. Carbon-14: ________________

**Thinking**


   __________________________________________________________

   __________________________________________________________

   __________________________________________________________

2. Explain why isotopes of the same element all have the same number of protons. Use the hydrogen isotopes as an example.

   __________________________________________________________

   __________________________________________________________

   __________________________________________________________

   __________________________________________________________
Understanding

1. What are ions?

2. Explain how a sodium atom becomes a sodium ion.

3. What is the ending in the name of a non-metal ion? ______________

4. If an ion has ‘-ate’ in its name, what element does the ion contain? ______________

5. Write the names of the following compounds.
   a. KOH: ______________
   b. LiCl: ______________
   c. Na₂SO₄: ______________
   d. Cu(OH)₂: ______________
   e. Al₂O₃: ______________

Thinking

1. Explain why an atom forms an ion.


3. Draw diagrams to show how:
   a. A magnesium atom forms a magnesium ion. The atomic number of magnesium is 12.

   b. An oxygen atom forms an oxide ion. The atomic number of oxygen is 8.
Chapter 2: Atoms
Bonding and ionic compounds

Questions from pages 41, 42 of ESA Study Guide Year 10 Science

Understanding

1. Define the term ‘compound’.

2. a. What type of atoms tend to lose electrons?

   b. What type of atoms tend to gain electrons?

3. Explain how an ionic bond forms between potassium atoms and chlorine atoms. The atomic number of potassium is 19. The atomic number of chlorine is 17.

4. Complete the following table.

<table>
<thead>
<tr>
<th>Compound – name and formula</th>
<th>Atoms present</th>
<th>Number of atoms</th>
<th>Total number of atoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>sodium chloride NaCl</td>
<td>sodium, Na</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>chlorine, Cl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>aluminium oxide Al₂O₃</td>
<td>aluminium,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Al</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>oxygen, O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lithium carbonate Li₂CO₃</td>
<td>lithium, Li</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>carbon, C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>oxygen, O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>calcium hydroxide Ca(OH)₂</td>
<td>calcium, Ca</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>hydrogen, H</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>oxygen, O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sodium hydrogen carbonate</td>
<td>sodium, Na</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(sodium bicarbonate) NaHCO₃</td>
<td>hydrogen, H</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>carbon, C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>oxygen, O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ammonium sulfate (NH₄)₂SO₄</td>
<td>nitrogen, N</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>hydrogen, H</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sulfur, S</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>oxygen, O</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Write the formulae for the following compounds:
   a. calcium oxide ____________
   b. sodium sulfide ____________
   c. potassium chloride ____________
   d. sodium sulfate ____________
   e. magnesium nitrate ____________

6. Write the names of the following compounds.
   a. K₂O: __________________________
   b. CaCO₃: __________________________
   c. FeCl₃: __________________________
   d. CuSO₄: __________________________

Thinking
1. Explain why one ion cannot form on its own.

   _____________________________________________________________

2. Why don’t gases such as helium and neon form compounds?

   _____________________________________________________________

3. Why should you never change the formula of a compound when you are balancing an equation?

   _____________________________________________________________

4. Explain why the formula for calcium hydroxide, Ca(OH)₂, needs brackets.

   _____________________________________________________________

5. Balance the following equations. Remember to put numbers in front of the formulae only. Do not change the formulae.
   a. Li + O₂ → Li₂O
   b. HCl + Mg → MgCl₂ + H₂
   c. CuCO₃ + HCl → CuCl₂ + CO₂ + H₂O

6. Convert these word equations to balanced chemical equations.
   a. copper + oxygen → copper oxide

   _____________________________________________________________

   b. calcium + water → calcium hydroxide + hydrogen gas

   _____________________________________________________________

Answers are provided on pages 294–296 of *ESA Study Guide Year 10 Science*